CHAPTER 8

FUNCTIONS OF SCIENCE GRANTING COUNCILS IN SUB-SAHARAN AFRICA

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Background

Science granting councils (SGCs) (and agencies with equivalent missions such as national commissions for science and technology, national sciences councils and national academies of science) are essential actors in national systems of innovation. In well-defined and clearly articulated systems of innovation they perform a number of crucial functions that contribute to the effective and efficient functioning of such systems, amongst others: disbursing funds for research and development (R&D); building research capacity through appropriate scholarships and bursaries; setting and monitoring research agendas and priorities; advising on science, technology and innovation (STI) policies; managing bilateral and multilateral science and technology (S&T) agreements; and assessing the communication, uptake and impact of publicly funded research. Ideally, such councils act as fair and disinterested agents of government while, at the same time, representing the interests of the scientific community nationally, regionally and internationally. They are crucial 'intermediaries' in the flow of international funding and technical support to R&D-performing institutions in a country.

Despite the significance of these organisations, few systematic studies of SGCs and related organisations in Africa have been done. This is in contrast to a growing body of scholarship about the nature, roles, functions and impacts of such bodies elsewhere in the world (see, for example, Barrier 2011; Braun 1998; Geuna & Martin 2003; Gulbrandsen 2005; Hubert & Louvel 2012; Jouvenet 2011; Laudel 2006; Lepori et al. 2007a, 2007b; Theves et al. 2007; Van der Meulen & Rip 1998).

After the decline in the 1990s in support for S&T development in Africa, there is now a renewed realisation by most role-players in recognising the importance of developing STI capacity in developing countries. High-profile reports outlining new visions, priorities and directions for African STI have emerged, particularly the UNESCO *Higher Education,*

Research and Innovation: Changing Dynamics (Meek et al. 2009) report, the African Union's *African Innovation Outlook* (2010) and the UN Rio+20 Report (United Nations 2012) as well as the World Bank Africa strategy in strengthening competitiveness and employment. These reports call for the international community's intervention to assist in promoting technology development, transfer and utilisation in Africa to enhance knowledge to support African countries to develop effective STI institutions, and the concomitant capacity to become global knowledge partners. The African continent is lagging substantially behind the rest of the world with regards to STI. The UN Millennium Project Report (2009) argues that STI underpins every one of the Millennium Development Goals and, therefore, becomes a prerequisite for sustainable development.

Against this background, the Centre for Research on Evaluation, Science and Technology at Stellenbosch University was commissioned by the International Development Research Centre in December 2012 to undertake a study on SGCs in 17 countries in sub-Saharan Africa. The countries included in the study were: Botswana, Burkina Faso, Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. The original project goal was to assess the strategic priorities, objectives and practices of SGCs in sub-Saharan Africa. In this chapter we report on the main findings of this study.

Science, technology and innovation systems in sub-Saharan Africa

SGCs are embedded in the science and innovation systems of their respective countries. In sub-Saharan Africa, the STI systems vary significantly with regard to socio-political histories, geography, political and economic (in)stability, colonial legacies and, most importantly (for this study), the degree of institutionalisation of R&D (Gaillard & Waast 1988; Mouton 2008). The R&D function of African STI systems is primarily located in universities, science councils, public research institutes and some research-based non-governmental organisations (Gaillard et al. 2005). There are few examples of well-established research institutes in the private sector or in industry.

Evolution and development of STI systems in sub-Saharan Africa

One of the first results of our study was to 'map' key milestones in S&T governance and policy development in each of the countries included in the study. These 'milestones' are presented in a comparative framework in Appendix Table A8.1, thus allowing for a comparison between each country's S&T trajectory and those of its continental counterparts.

Most African countries obtained their independence during the 1960s. But the establishment of a national ministry of science and technology (or equivalent ministry) would have to wait, in most cases, for another 20 years to materialise. In fact, in four countries (Namibia, Rwanda,

Tanzania and Uganda) there is as yet no such dedicated ministry. In most of these cases, the S&T portfolio is located in a ministry of higher education. One country, Cameroon, does not have a science policy document. These facts may point to a lack of commitment to prioritise S&T matters in these countries. On the other hand, we also found evidence of a recent commitment to prioritising S&T as illustrated by the fact that nine countries have revised their S&T policy documents since 2010.

The overarching impression that one gains from this overview of critical dates in the development and establishment of STI policies and institutions is that most of the countries in sub-Saharan Africa have only, in recent years, given sufficient priority to science and innovation matters. As we will see in the section below, a commitment to a science policy or ministry of science and technology is not sufficient if it is not accompanied by an investment in R&D in a country. The reality is that most governments in sub-Saharan Africa have until now only paid lip-service to prioritising S&T and allocating sufficient funding for research.

Investment in R&D

The New Partnership for Africa's Development (NEPAD) is the socio-economic development programme of the African Union. It is a high-level platform for developing policies and setting priorities on STI for African development. The STI vision of NEPAD is that of 'an Africa that is well integrated into the global economy and free of poverty' (NEPAD 2005). The overall goals are:

- To enable Africa to harness and apply science, technology and related innovations in order to eradicate poverty and achieve sustainable development; and
- To ensure that Africa contributes to the global pool of scientific knowledge and technological innovations.

In accordance with the NEPAD objectives, many African governments have committed themselves to increasing their gross domestic expenditure on R&D (GERD), and to put in place the necessary policies to enact such decisions by 2015. GERD is generally regarded as a measure of how dedicated a specific country is to supporting research. But the reality is that most sub-Saharan Africa countries spend less than 0.5% of their gross domestic product (GDP) on R&D (see Table 8.1). Nigeria, for example, lags far behind in that only 0.20% of its GDP is assigned towards the development of R&D (*African Innovation Outlook 2010*: 37). Unfortunately, not all sub-Saharan African countries' GERD is captured in the statistics below and Table 8.1 therefore does not present a comprehensive view of GERD in the region. However, it can be assumed that sub-Saharan Africa needs a timely injection of funds into STI and R&D.

Table 8.1 Gross domestic expenditure on R&D (GERD)

	African Innovation Outlook				UNESCO† Institute for Statistics
Country	Year	GERD Million PPPS	GERD per capita PPPS	GERD as % of GDP	GERD as % of GDP
Botswana	2005	n/a	n/a	0.38	0.52 (2005)
Burkina Faso	2009	n/a	n/a	0.18	0.20 (2009)
Cameroon	n/a	n/a	n/a	n/a	n/a
Côte d'Ivoire	n/a	n/a	n/a	n/a	n/a
Ethiopia	2005	n/a	n/a	0.2	0.24 (2010)
Ghana	2008	78.7	58.3	0.47	0.23 (2007)
Kenya	2007	277.8	7.4	0.38	0.42 (2007)
Malawi	2007	180.1	12.9	1.70	n/a
Mozambique*‡	2007	42.9	2.0	0.25	0.47 (2010)
Namibia	2005	n/a	n/a	0.3	n/a
Nigeria*†	2007	583.2	3.9	0.20	0.22 (2007)
Senegal	2008	99.0	8.0	0.48	0.37 (2008)
South Africa$^{\Omega}$	2010/11	4 976.6	102.4	0.76	0.87 (2009/10)
Tanzania*	2007	234.6	5.8	0.48	n/a
Uganda†	2007	359.8	11.6	1.10	0.41 (2009)
Zambia	2008	55.3	4.6	0.37	0.34 (2008)
Zimbabwe	2005	n/a	n/a	0.2	n/a

* Data do not include the business enterprise sector
† Data do not include private non-profit institutions/organisations
‡ Data do not include the higher education sector
Ω HSRC CESTII Report (August 2013)
† We have added an additional column to include the latest available UIS statistics on R&D investment for select countries

Source: African Union (2010: 34)[1]

It is also worth noting what percentage of GERD is sourced from funds abroad. Table 8.2 provides the available statistics as published in 2010 for those countries that source funds from abroad. Mozambique receives almost 58% of funding available for GERD from foreign sources, while Nigeria sources 99% of funding towards GERD internally. The figures suggest that sub-Saharan Africa, with the exception of Nigeria, South Africa and Ghana, is still heavily reliant on foreign funding as a source for R&D activities.

1 Cameroon and Côte d'Ivoire were not included in the survey.

Table 8.2 Dependency on foreign funding for R&D in 2010 (%) (sub-Saharan Africa only)

Country	Funds from abroad
Ghana	11.9
Kenya	17.6
Malawi	33.1
Mozambique	57.3
Nigeria	1.0
Senegal	38.3
South Africa	10.7
Tanzania	38.4
Uganda	12.8
Zambia	1.7

Source: African Union (2010: 40)

Research funding models

We now turn to a more detailed discussion of the nature, status and functions of national research funding bodies (in cases where such an entity exists), while also exploring the coordination of funding within national science institutions in terms of its integration, coordination or fragmentation. The former will consider the legal status of national funding bodies (granting councils) either as an entity within a ministry, a semi-autonomous public institution outside the ministry, a private foundation, and so forth.

Appendix Table A8.2 summarises the high-level results of our analysis of national STI funding arrangements in the 17 countries of interest. A three-level classification is used, specifying the *fund or funding programme;* whether the fund is embedded within or overseen by a *funding council* or equivalent body; and the relevant *ministry* that oversees either (or both) the funding council and fund. Where applicable, an attempt has been made to also distinguish between current and proposed funding arrangements.

The salient points emerging from the summary presented in Appendix Table A8.2 are highlighted below.

Differences between Anglophone and Francophone countries

As can be seen, a dedicated science funding council is largely a feature of the STI systems of countries in the Anglophone tradition (e.g. Kenya, South Africa, Uganda, Zambia and Zimbabwe). In the Francophone countries, such as Rwanda and Cameroon, there are no STI funding councils (although a project to establish a National Fund for Research and Innovation is currently being discussed in Cameroon). Burkina Faso, Côte d'Ivoire and Senegal, however,

do have dedicated funding agencies. In the case of Côte d'Ivoire and Senegal, funding systems promoting agricultural research have recently been established.

As Appendix Table A8.3 shows, the creation of SGCs and competitive research funds is of a rather recent origin in sub-Saharan Africa. Over the past decade, however, we have seen an increase in either the establishment of dedicated SGCs or agencies, or the promulgation of policies which stipulate that such agencies must be established in the foreseeable future. All of this points to a general and emerging consensus as to the necessity of having such councils as part of the national science system.

Separation of funding for research and innovation

A second emerging trend is the separation of funding councils for research and innovation. This trend, which is well established in many European countries and other modern science systems, is evident in a few countries in our study. Examples of this trend are found in South Africa (with the different mandates of the National Research Foundation and the Technology Innovation Agency); Kenya (National Research Fund and the Kenya National Innovation Agency); Botswana (with a separate National Innovation Fund); and Zimbabwe (with the Research Council of Zimbabwe and the Research and Development Commercialisation and Innovation Fund). Even where funding for basic research and innovation are not separated into two different funding agencies, there is clear evidence that countries in sub-Saharan Africa appreciate the importance of separating funding for research and innovation. So, for example, countries such as Cameroon and Nigeria have proposed a national research *and* innovation fund.

Different configurations of science funding agencies

Arguably, one of the main findings of our study relates to the wide range and diversity of science funding configurations in the selected countries. Using the widely accepted principal-agent framework, a number of questions presented themselves. For instance, what is the role of a principal of a fund (where a principal refers to either a ministry or STI funding council)? Does the principal only provide technical supervision or also financial supervision? Which mechanisms/structures are available to the principal to ensure that the fund is implemented according to certain guidelines (e.g. national development goals)? Moreover, in the case of STI funding councils acting as agent of a ministry (principal), it could be asked to what extent they are only conduits to channel funds and how much decision-making power they really have; for example, do they manage the funds apart from (partially or fully) administering the funds?

The following serve as examples of how these questions are addressed quite differently in different countries:

- In Ghana, the Council for Scientific and Industrial Research (CSIR) coordinates and administers the operations of the Science and Technology Research Endowment Fund

(STREFund). The STREFund is an independent funding mechanism. One mechanism by which the Ministry of Environment, Science and Technology (principal) ensures that the CSIR (agent) is serving the interests of government in its administration of the fund is through co-representation. The STREFund is governed by a board of trustees of nine persons representing the CSIR, the Association of Ghana Industries, the Ministry of Finance and Economic Planning, universities, the National Council for Tertiary Education, the Ghana Academy of Arts and Sciences, and the Ghana Atomic Energy Commission. At the same time, it could be argued that the representative board is also a mechanism by which the fund itself (as a second layer of agent) satisfies the interests of the CSIR as its immediate principal.

- A similar scenario could be observed in the case of Tanzania. The Tanzania Commission for Science and Technology (COSTECH) (the agent) is a government institution under the Ministry of Communication, Science and Technology (the principal). The National Fund for the Advancement of Science and Technology is located within the structure of COSTECH. The fund is an inter-ministerial fund channelled by the Treasury through the Ministry of Communication, Science and Technology. The fund is administered by an inter-ministerial and multi-sectoral committee, which comprises representatives of the relevant ministries (President's Office, Treasury, Planning Commission, Communication, Science), the Bank of Tanzania, the National University, the Chamber of Commerce, Agriculture and Industry, and the Director General of COSTECH. Thus, through representation on the committee, government, as principal, can ensure that COSTECH, as primary agent, is executing the fund in a manner that meets the national interest.
- In the case of Zambia, the National Science and Technology Council (NSTC) (agent) administers the Strategic Research Fund on behalf of the Department of Science and Technology in the Ministry of Education, Science, Vocational Training and Early Education (the principal). The mechanism by which the Ministry ensures that the NSTC serves the national interest in the administration of the fund is through dual fund management. The Strategic Research Fund is managed by two committees: the Technical Committee of the NSTC and the Fund Management Committee of the Ministry.

Functions of research funding agencies

Studies about the functions of science funding agencies typically identify three areas: selection, policy and control. We elaborate on each before discussing the empirical findings of our study.

In the *selection arena*, funding projects are selected either by anonymous scientific referees, mail review or by scientific peer-review groups. Administrators are considered to be brokers within these review groups. For refereeing, criteria are supplied by the funding

agency, and there is some selection of the 'right' referees by staff of the agency. After refereeing, the proposals, review reports and other documents are put together and ranked, and authoritative decisions eventually lead to the allocation of funds. To put it briefly: 'the business of a funding agency is: proposals in, money out' (Rip 2000: 469). It is important to discuss the peer-review process as it is vital to our understanding of the decisions and processes in the selection arena.

The majority of projects selected by initial peer review are typically transferred to more encompassing scientific boards, which check for compliance with the general mission of the funding agency. While initial peer-review groups do control for scientific quality and, if need be, for pick-a-back criteria, scientific boards take account of the relevance of research projects – either for the scientific community or for external communities. Even during the check there can be no doubt that scientific quality remains the main criterion for the selection of projects; only rarely will one find projects that have been funded because they fulfil the programmatic criterion while the scientific quality was not certified (Braun 1998: 814).

There are two dominant procedures that have been chosen as peer-review procedures in funding agencies, with somewhat different implications for the selection process: the anonymous mail review by individual referees (e.g. by the Deutsche Forschungsgemeinschaft in Germany and the National Science Foundation in the United States); and the peer-review group, which is the predominant form found in funding agencies. Some granting councils (e.g. the International Foundation for Science) are using both procedures simultaneously, which is particularly useful in the case of disagreement within the peer-review group. As has already been pointed out, the legitimate norms of distributing funding resources are at this stage clearly inspired by the promotion of scientific quality. There are no differences in this respect between funding agencies. This means that funding administrators do not interfere in order to claim the application of relevance norms at this stage. Thus, only the specific interests and positions of scientific referees matter with regard to the outcome of the distribution game. Criteria used in the reviews include, for example, the quality of the research design and the theories chosen; the consideration of former research; the originality of the research; its significance for the advancement of knowledge; and the qualification of the applicant (ibid.: 815).

Evaluation is also used to decide funding, following performance assessments of researchers, projects, programmes, departments and institutions. The assumption is that funds that are allocated after performance is evaluated will yield greater returns (Geuna & Martin 2003: 278). In the United Kingdom, this is the responsibility of the Higher Education Funding Councils, while in the Netherlands, evaluations are carried out by the Association of Netherlands Universities: the former use evaluation as a method of allocating funds, while the latter uses evaluation as a management tool. Different agencies also employ different criteria. They tend to focus on four typical output measures: volume, quality, impact and utility. Peer review and bibliometric measures are their main methods. In peer review, the unit of assessment is normally the 'project' or the 'individual'. However, because bibliometric analyses cannot usefully be applied across the board to all departments in a large number of universities, peer review has become the principal

method of university assessment as well. When supplemented by publication and citation data and other information, this method is called 'informed peer review' (ibid.: 279).

Peer review's main virtue lies in the assumption that it is ostensibly meritocratic – rewarding success and improving quality. A performance-based system can increase efficiency in the short term while also providing greater accountability. It provides a mechanism to link research to policy, a way to shift priorities across fields, and a rational method for moving resources from less well-performing areas to areas where they can be used to greater effect. While these arguments have their merits, a performance-based system also has its drawbacks. Firstly, obtaining reliable and comparable information is costly. Assessments based on peer review are especially labour-intensive, when all a nation's universities and their constituent departments have to be judged. Nor do indicator-based approaches offer a shortcut; if conclusions are to be robust, data must be accurate and reliable. Secondly, a performance-based funding system, because it encourages competition, may also encourage a shift towards the 'homogenisation' of research, discouraging experiments with new approaches and rewarding 'safe' research, irrespective of its benefits to society. The resulting decrease in diversity may be harmful. Moreover, a system that has publication as a key criterion encourages 'publication inflation'. Some academics will almost certainly respond by 'game-playing' without necessarily improving performance. Thirdly, performance-based funding can widen the gap between research and teaching; if rewards for research are greater than rewards for teaching, academics will focus on the former at the expense of the latter (ibid.: 296).

The term *policy arena* indicates that it is the function of these boards to define the 'intermediate goals' as well as the strategies to realise them by taking into account the 'constitutional' mission of the funding agency. In the policy arena we find scientific boards responsible for the second step review and, occasionally, additional boards (Braun 1998: 815). It is within the policy arena that goal conflicts occur. Tension between basic versus applied research is a fundamental stressor that results from a convergence between academic and mission-orientated funding sources. It is also in the policy arena that we find tension between steering and aggregation (Gulbransen 2005), as will be discussed in the following section.

In the *control arena*, the majority of publicly financed funding agencies have established a political board, which functions as an interface between the funding agencies and their environment – most notably the grant-givers from the political system. Political representatives sit on the boards of the financing agencies while the research management – who are supported by scientists – defend research policy and budget decisions. It is especially in this arena where political actors may interfere with policy or funding decisions.

In summary, the literature argues that funding agencies are tasked with quality control, allocation decisions and (developing/implementing) research policy. As intermediary public agencies, they receive public funds and seek to add value to these funds by selective distribution for high-quality research. All such agencies are concerned with control for quality. All are national agencies, with national missions, albeit defined in very different ways (Caswill 2004: 8). Caswill (2005) argues that there are a eight core tasks of funding agencies

that support a large variety of research council organisations and processes in the context of different sciences and national cultures. According to Caswill (ibid.), these are context-free components of the late 20th and early 21st century modern research council, which we can label as 'core essential' tasks. These include providing resources for research, maximising organisational resources, input of ideas, quality control, interconnection, national location, resource allocation, and delegation.

Our study has found that SGCs in sub-Saharan Africa perform a much wider range of functions than those identified in the literature. In fact, many of the functions that they perform are not even directly related to science funding per se. We summarise the functions performed by the science councils/funds/commissions identified in the 17 selected countries below. These functions are not derived from a strong notion of a well-functioning SGC (as found in the literature or even from studies elsewhere), but rather derived (inductively) from the actual activities in which SGCs in sub-Saharan Africa are engaged.

We have identified 12 areas in which SGCs typically operate. The first three can be regarded as different forms of science funding support and, therefore, speak to the core mission of a funding agency. But functions such as the dissemination of research findings, support for scientific publishing, and the collection of R&D data and statistics, are new functions that were also found to be performed by many of the SGCs in the selected countries. The 12 identified areas in which the SGCs were operating include the following:

1. Disbursement of research grants (various categories);
2. Disbursements of scholarships and loans (mostly masters and doctoral students);
3. Funding support for infrastructure development;
4. Valorisation of results (dissemination and uptake of research reports and findings);
5. Supporting scientific publishing/scientific journals;
6. Advocacy for STI;
7. Collection of data and statistics on S&T and R&D;
8. Capacity-building/training of researchers;
9. Policy advice;
10. Setting research agendas/research priorities;
11. Management of scientific collaborations and agreements; and
12. Coordination of the national innovation system.

Disbursement of research grants (various categories)

An important difference in the way in which different SGCs disburse funds to the scientific community has emerged from our study. Some councils function as research *granting* agencies in the true sense of the word (i.e. inviting applications, managing a peer-review process and then subsequently awarding funds on the basis of merit and other relevant criteria). Many of the

funding councils included in this study disburse research grants in this way.[2] For example, the Research Council of Zimbabwe (RCZ) funds research in all fields according to a set of national priority areas; the same applies to the National Research Foundation (NRF) in South Africa.

But in many countries, research is commissioned rather than supported through research grants.[3] Research conducted by inter-institutional and multidisciplinary teams and including short-term training is particularly encouraged. Each research team must have at least three partners with the possibility of an associate at regional or international research organisations operating in the national territory.

Disbursements of scholarships and loans (mostly masters and doctoral students)

Supporting postgraduate students (honours, masters and doctoral students) is one of the traditional functions of SGCs. The study found that this is the case in the majority of countries investigated. However, it was surprising to note that this is not the case in all countries. In countries such as Botswana, Ghana, Ethiopia, Kenya, Uganda and Zambia such scholarships are not available through the national granting councils. It is possible that another institution (such as a ministry of higher education) could perform this function in these countries. It is more likely, though, that international agencies provide the bulk of masters and doctoral scholarships in many of these countries because of the lack of such support from the local government. This is an area that requires further investigation.

Support for infrastructure development

We have found few examples where SGCs provide funding and support for scientific infrastructure and equipment. The NRF in South Africa is an exception. Another example is in Côte d'Ivoire where the Inter-professional Fund for Agricultural Research and Council (FIRCA) works with the agricultural sector by providing for the training of producers and supporting sector-based organisations' structures. This involves developing process manuals and development plans, and assisting in the consolidation of the associations. FIRCA also supports associations by funding the following:

- Generating technologies to meet the needs of producers;
- Transferring and diffusing technology in the medium-term;
- Increasing production;
- Improving the productivity of farms;
- Putting quality products on the market; and

2 Grants are non-repayable funds disbursed by one party (grant-makers) (often a government department, corporation, foundation or trust) to a recipient (often, but not always, a non-profit entity, educational institution, business or individual).

3 Commissioned research is research requested by an external party in exchange for payment.

- Training and building the capacity of farmers and their organisations for greater professionalism.

Valorisation of results (dissemination and uptake of research reports and findings)

SGCs are increasingly getting involved in adding value to research findings and outcomes that they fund. The international trend towards issues related to maximising research uptake and impact is also evident in Africa, although on a much smaller scale. Some examples were found in Burkina Faso where the National Fund for Research and Innovation for Development (FONRID) participates in the uptake of research results and technological innovations, by funding result-focused or uptake activities. COSTECH is mandated to take the lead in gathering and disseminating research results in Tanzania, and in Zambia, the NSTC is responsible for collecting and disseminating S&T information, including publication of scientific reports, journals and other such documents and literature.

Supporting scientific publishing/scientific journals

Related to the valorisation of results is an interest in supporting scientific publishing in a country. In South Africa this function is not performed by the NRF but by the Academy of Science of South Africa (with generous support from the Department of Science Technology). In Ethiopia, in the past, the Ethiopian Science and Technology Agency (ESTA) benefitted from a generous grant from the Swedish International Development Cooperation Agency that supported the publication of national science journals. In Burkina Faso, FONRID also funds quality scientific and technical publications as part of research projects, and the RCZ in Zimbabwe supports the publication of six national journals: the *Central African Journal of Medicine*, *Journal of Applied Sciences in Southern Africa*, *Journal of Science and Technology*, *Zimbabwe Science News*, *Zimbabwe Veterinary Journal,* and *Zambezia Journal of Humanities*. Given the precarious state of scientific journals on the African continent and the general lack of visibility of African science in international databases and indexes, this is clearly an area where SGCs could play a bigger role.

Advocacy for STI

In Ghana, the proposed National Research Funding Council will be responsible for providing STI advocacy, so that the voice of the country's STI community will be represented in the country's programmes and policies at all levels. The NCST in Kenya conducted various activities aimed at creating awareness relating to STI in Kenya. An example of this is the training, conducted in 2012, of public relations and communications officers on biosafety. The intention of this training was to create a critical mass of communicators. They can then provide factual information on biosafety issues to both policy-makers and to the public. A further

example is the participation of NCST staff in the Strategic Trade Control and Security training of 2012, attended by 52 participants from 13 countries. In 2012, the NCST also participated in activities such as the micro and small enterprise innovation and technology exhibition and symposium. This event was sponsored by the NCST and aimed to create a forum to bring together innovators, research institutions, technology providers and the general public. Other examples include the 2012 and 2013 participation of the NCST/NACOSTI in the Agricultural Society of Kenya show in Mombasa and in the Nairobi International Trade Fair.

Collection of data and statistics on S&T and R&D

It is imperative that reliable and regular statistical information on R&D in a country is produced. There are very different national models of how and where this function is performed. For example, in Canada, the R&D statistics are gathered and analysed by StatsCanada; in the United States, the National Science Foundation produces such data on a regular basis. In South Africa, a unit within the Human Sciences Research Council (the Centre for Science, Technology and Innovation Indicators) performs this function, although it used to be housed in the precursor to the NRF. Our research showed that the collection and analysis of R&D statistics is housed in a few SGCs. The Uganda National Council for Science and Technology (UNCST) is one of the few organisations that collect and analyse scientific and technological statistics and indicators to facilitate measurement and provide advice to government. The NCST regularly evaluates sector performance using conventional and standardised STI indicators, and publishes these in the annual STI status reports.

Capacity-building/training of researchers

Given the lack of research culture in the Francophone countries, many of the SGCs studied in West Africa are concerned with training of researchers, particularly with regards to proposal writing and technical support. FONRID in Burkina Faso offers support to public and private research and technological innovations, laboratory equipment or workshops as part of specific programmes of research and development approved by the Fund.

Policy advice

The literature shows that some SGCs do in fact play a role in advising government on science and innovation policy. It is important to emphasise that this does not usually involve the development of policy, but more typically advising on policy (and in some cases evaluating policy). In Rwanda, the NCST is currently operational with the mandate of providing informed policy recommendations to the government and advice on human capacity-building strategies, in order to ensure that Rwanda is equipped with a critical mass of highly qualified skills in S&T to support the achievement of a competitive and sustainable socio-economic

development based on STI. The RCZ in Zimbabwe is also mandated to advise the government on matters of research. COSTECH in Tanzania is the principal advisor to the government on matters pertaining to S&T and its relevance to the socio-economic development of the country. In Uganda, the UNCST is responsible for preparing policy notes to inform policy-makers, scientists and the public on matters related to technology forecasting, assessment and transfer. In Zambia, the NSTC is mandated to regulate research in S&T; register institutes and centres; and advise the government on S&T policies and activities in the country.

Setting research agenda/research priorities

Because of their strategic position within national science systems, SGCs typically advise government on national research priorities and new initiatives. This advice is often grounded in research projects funded and feedback from peer-review process, as well as on the basis of regular reviews of scientific fields and disciplines. The NRF in South Africa is a good example where this is regularly done. Over the past ten years it has commissioned various studies that reviewed its funding instruments, as well as evaluations of specific fields (such as mathematics and physics). The fact that the NRF also houses a directorate on 'new knowledge fields' is another indication of the role that it performs in co-constructing the national research agenda. Other examples from our study include the National Research and Innovation Council (NRIC) in Nigeria, which is mandated to set national priorities on R&D and to set direction to coordinate STI activities, including R&D, in line with national priorities; and the Zambian NSTC, which identifies and determines national R&D priorities in S&T.

Management of scientific collaborations and agreements

Various bodies in the national science system are typically involved in the management of international agreements and collaborative networks. It is uncommon to find that national academies of science perform this role. In many countries this function is performed by the ministry or national department of science and technology and, as we found, also by national granting councils. In South Africa, the NRF has traditionally played a central role in managing bilateral and multilateral science agreements. More recently, it has increased its involvement in this arena by appointing 'national contact persons' to mediate between the South African scientific community and the European Union (and its various frameworks and funding instruments).

Other examples of SGCs which perform a similar function were found in our study. FONRID in Burkina Faso is responsible for, amongst others, the mediation between national partners, bilateral or multilateral structures and public or private research structures in the negotiation, development and implementation of projects or research programmes. In Uganda, the UNCST is responsible for developing partnerships and networks among different stakeholders through the creation of technical working groups to steer and oversee particular

National Science, Technology and Innovation Plan programmes and projects. The NSTC in Zambia is responsible for establishing and maintaining a relationship with corresponding scientific organisations in other countries.

Coordination of the national innovation system

Finally, many of the country analyses revealed a weak or fragmented national innovation system. There has been an effort to rectify this constraint with the proposal of many new councils/funds/commissions. An example is the National Research Funding Council in Ghana, which will be responsible for ensuring coordination and harmonisation of the country's STI policies, so that STI activities are comprehensive, complementary and reinforcing across all sectors and ministries.

Concluding comments

SGCs (and equivalent bodies) in sub-Saharan Africa are at different stages of development. Some councils (e.g. in South Africa, Tanzania, Kenya and Zimbabwe) are well established, whereas others (as in Namibia, Botswana and Mozambique) are in their early stages of establishment. Francophone countries (such as Burkina Faso, Senegal and Cameroon) have very different institutional arrangements, where competitive funding and the associated practices are of a more recent origin and less well-established. In many of the countries included in the study, the national landscape is characterised by a multitude of funding agencies, programmes and instruments often organised around sectoral interests (e.g. health and agriculture). In addition, these councils face a variety of challenges (e.g. resource constraints, governance issues, lack of clarity on institutional differentiation, lack of coordination within science systems, marginalisation of influence, and so on). There is little evidence of sharing of expertise and experience amongst SGCs – often within the same country, but definitely within regions and across the continent.

The differentiated landscape of research funding models found in this study is not only the result of different histories in science policy development and different trajectories in the institutionalisation of a science ministry in the respective countries, but also reflects different science governance models. As we have seen, these governance models are related to the historical roots of these systems in the British and French models of science management. However, we have also seen that more recent trends, which include the notion of 'national systems of innovation', are reflected in the separation of funding (basic) research and innovation.

The relatively poor investment in R&D in many sub-Saharan Africa countries, which has a direct impact on the science funding models, points to different 'inscriptions' of science in different countries as well as different values afforded to science. On the one hand, some governments clearly recognise the value and importance of science and hence invest in science funding and the establishment of a national funding agency. On the other hand, many governments have not – at least until very recently – judged science to be of sufficient value

and importance to invest in the establishment of a relatively autonomous agency to disburse state funds for R&D. Having said this, the fact that there has been a surge of interest in the recent past in reformulating existing science policies, as well as the establishment of a separate ministry of science, may be indicative of a change, even amongst the latter categories of countries.

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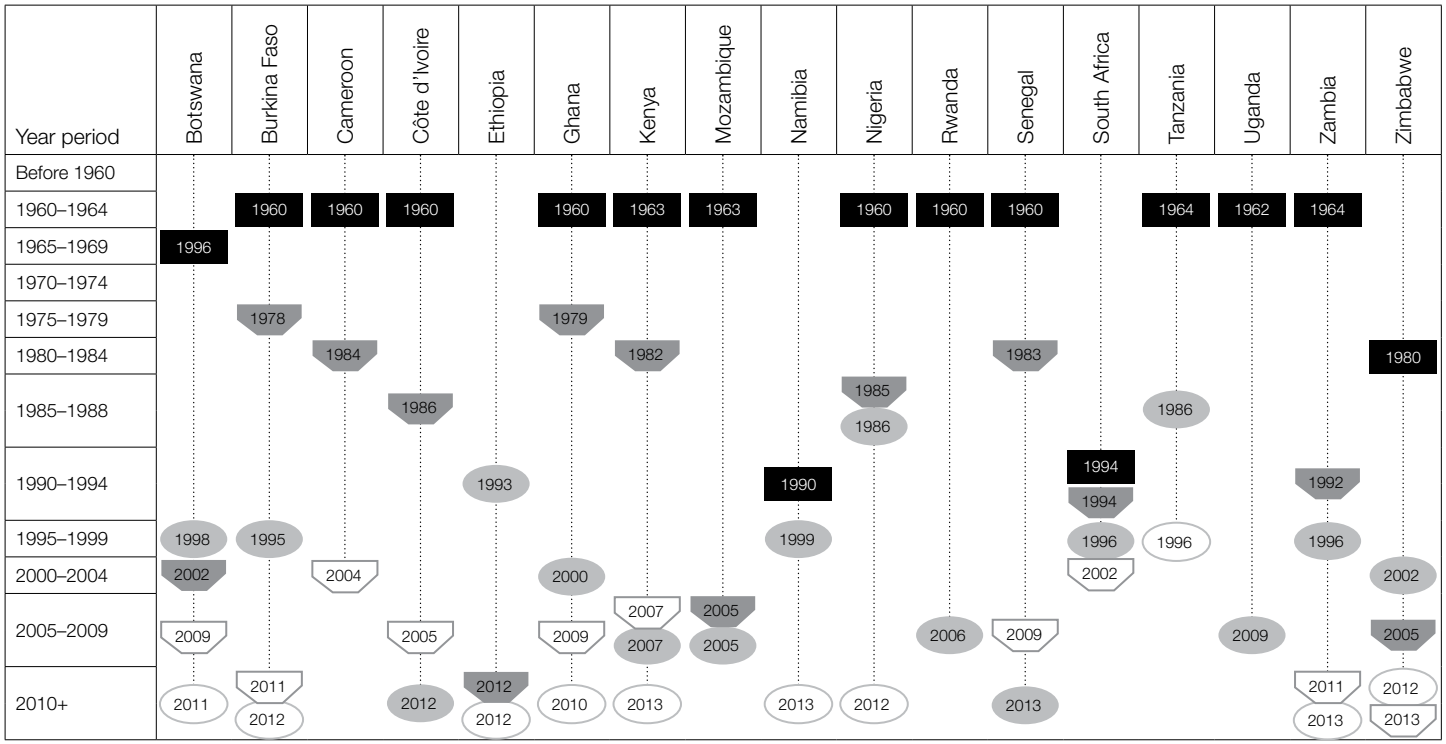
Table A8.1 Selected 'milestones' in science and technology governance and policy-making, by country



Note: The 'milestones' are displayed chronologically using the legend below:

Independence
First S&T ministry
Last change in S&T ministry
First S&T policy
Last revision of S&T policy

Table A8.2 Funding bodies in the 17 selected countries

Country	Ministries/departments	Funding councils/intermediaries	Funds/funding instruments
BOTSWANA (Current)	Department of Research, Science and Technology in the Ministry of Infrastructure, Science and Technology directly funds R&D		
	Ministry of Education and Skills Development	Tertiary Education Council	Sectoral Research Funds (competitive) under the Tertiary Education Council Funding Model for Botswana
	National Commission for Science and Technology		Training of Scientists and Technologists Fund
BOTSWANA (Supposed to be operational by now but evidence is lacking)	Department of Research, Science and Technology in the Ministry of Infrastructure, Science and Technology	Botswana Research, Science and Technology Funding Agency	
		Botswana Innovation Hub	Innovation Fund
BOTSWANA (Proposed)	Department of Research, Science and Technology, to become a Directorate in the Botswana National Research, Development and Innovation Coordinating Council		National Research Fund
BURKINA FASO	Ministry of Scientific Research and Innovation	National Fund for Research and Innovation for Development (*Le Fonds National de la Recherche et de l'Innovation pour le Développement*)	
	Ministry of Secondary and Higher Education	National Fund for Education and Research (*Le Fonds National pour l'Education et la Recherche*)	
	Research Health Directorate of the Ministry of Health		Fund for the Support of Health Research (*Fonds d'Appui à la Recherche en Santé*)

Country	Ministries/departments	Funding councils/intermediaries	Funds/funding instruments
CAMEROON (Current)	Ministry of Scientific Research and Innovation		Competitive Research Fund (*Fonds de Recherche sur Base Competitive au Cameroun*) (for agricultural research)
	Ministry of Higher Education, Support to Education System Programme (*Programme d'Appui au Système de l'Enseignement*)		Fund for Support to Research and Professionalisation (*Fonds d'Appui à la Recherche et à la Professionalisation*)
			Fund for the Development of Cocoa and Coffee Sectors (*Fonds de Développement des filières Cacao et Café*)
			Competitive fund to reward researchers, including for Scientific Research and Innovation Excellence Week (*Journées de l'Excellence de la Recherche Scientifique et de l'Innovation au Cameroun*)
			Fund to Support Research, the University Fund for Dissemination of Scientific and Technical Information
CAMEROON (Proposed)	Ministry of Scientific Research and Innovation		National Fund for Research and Innovation (*Fonds National de la Recherche et de l'Innovation*)
CÔTE D'IVOIRE	Ministry of Higher Education and Scientific Research	Strategic Support for Scientific Research Programme in Côte d'Ivoire (*Programme d'Appui Stratégique à la Recherche Scientifique*)	
	Ministry of Agriculture	Interprofessional Fund for Agricultural Research and Council *(Fonds Interprofessional pour La Recherche et le Conseil Agricoles*)	
CÔTE D'IVOIRE (Proposed)	Ministry of Higher Education and Scientific Research	National Fund for Scientific and Technological Research (*Fonds National de la Recherche Scientifique et Technologique*)	
ETHIOPIA (Current)	Ministry of Science and Technology		Local Research and Development Grant
ETHIOPIA (Proposed)	Ministry of Science, Technology and Innovation	National Science, Technology and Innovation Council	
GHANA (Current)	Ministry of Environment, Science and Technology	Council for Scientific and Industrial Research	Science and Technology Research Endowment Fund
	Ministry of Education		Ghana Education Trust Fund
GHANA (Proposed)		National Research Funding Council (apex body)	
KENYA (Current)	Department of Science and Technology in the Ministry of Education, Science and Technology	National Council for Science and Technology	Science, Technology and Innovation Fund

Country	Ministries/departments	Funding councils/intermediaries	Funds/funding instruments
KENYA (Proposed)	Department of Science and Technology in the Ministry of Education, Science and Technology	National Commission for Science, Technology and Innovation	National Research Fund
			Kenya National Innovation Agency
MOZAMBIQUE (Current)	Ministry of Science and Technology		Fund for Poverty Research (*Fundo de Investigação sobre Pobreza*)
MOZAMBIQUE (Proposed)	Ministry of Science and Technology		National Research Fund
NAMIBIA (Current)	Line ministries fund research, researchers and research institutes operating with the ministries		
NAMIBIA (Proposed)	Ministry of Higher Education	National Commission for Research, Science and Technology	National Research Fund
		Council for Research and Innovation	
NIGERIA (Current)	Research funding by the various ministries (i.e. Federal Ministries of Health, Agriculture, and Environment)		
			Tertiary Education Trust Fund
NIGERIA (Proposed)	Ministry of Science and Technology		National Research and Innovation Fund
		National Research and Innovation Council	
		State Science, Technology and Innovation Council	
		National Council on Science, Technology and Innovation	
			Education Trust Fund Research Fund
RWANDA (Current)	Directorate of Science, Technology and Research in the Ministry of Education directly funds research in the country		
	Ministry of Education		Rwanda Research Innovation Endowment Fund
RWANDA (Proposed)	Directorate of Science, Technology and Research in the Ministry of Education directly funds research in the country	National Commission for Science, Technology and Innovation	National Research Fund
SENEGAL (Current)	Ministry of Higher Education and Research	Fund to promote Scientific and Technical Research (*Fonds d'Impulsion de la Recherche Scientifique et Technique*)	
	Ministry in charge of Agriculture	National Fund for Agriculture and Agrifood Research (*Fonds National de Recherches Agricoles et Agro-Alimentaires*)	

Country	Ministries/departments	Funding councils/intermediaries	Funds/funding instruments
SENEGAL (Proposed)	Ministry of Higher Education and Research	National Fund for Research and Innovation	
SOUTH AFRICA	Department of Science and Technology	National Research Foundation	Various funding instruments
		Technology Innovation Agency	Four funding instruments
	Department of Health	Medical Research Council	Various funding instruments
	Department of Water and Environmental Affairs	Water Research Commission	Two funding instruments
TANZANIA (Current)	Ministry of Communication, Science and Technology	Tanzania Commission for Science and Technology	National Fund for the Advancement of Science and Technology
TANZANIA (Proposed)		Tanzania Commission for Science and Technology	National Research Fund (to replace NFAST)
UGANDA	Treasury		Presidential Science Initiative
	Ministry of Finance Planning and Economic Development	Uganda National Council for Science and Technology	Science, Technology and Innovation Fund
			National Innovation Fund
ZAMBIA (Current)	Department of Science and Technology in the Ministry of Education, Science, Vocational Training and Early Education	National Science and Technology Council	Two funding instruments (Strategic Research Fund and Science and Technology Innovation Youth Fund)
		National Technology Business Centre	National Technology Business Fund
ZAMBIA (Proposed)	Department of Science and Technology in the Ministry of Education, Science, Vocational Training and Early Education	National Research Council	None, as it will not be a funding agency
			National Research and Innovation Fund
		National Technology Innovation Agency	Unknown
ZIMBABWE	Ministry of Higher and Tertiary Education, Science and Technology Development	Research Council of Zimbabwe	Two funding instruments (small research grants for masters and doctoral students and large research grants open to all)
			Research and Development Commercialisation and Innovation Fund

Table A8.3 The rise of science granting councils and competitive research funds in sub-Saharan Africa

Countries	Research councils/foundations	Year of creation
Botswana	NRF	To be established
	NCST	2002
	Innovation Fund	To be established
	BRSTFA	To be established
	TEC	1999
	BIH	2013
	BNRDCC	To be established
Burkina Faso	*FONRID*	2011
	FONER	1994
	FARES	2008
Cameroon	FRBC	2009
	FARP	2009
	FNRI	To be established
Côte d'Ivoire	*PASRES*	2007
	FIRCA	2002
	FNRST	To be established
Ethiopia	*NSTIC*	To be established
Ghana	*CSIR*	1969
	STREFUND	2008
	GETFUND	2000
	NRFC	To be established
Kenya	NRF	2013
	KENIA	2013
	NCST	1977 (replaced with NACOSTI)
	NACOSTI	2013
Mozambique	NRF	2009
Namibia	NRF	To be established
	NCRST	2013
	CRI	To be established
Nigeria	TETFUND	2011
	NRIF	To be established
	NRIC	To be established
	SSTIC	To be established
	NCSTI	To be established
	ETF	2009
Rwanda	NRF	To be established
	RIEF	2012
	NCSTI	2013

Countries	Research councils/foundations	Year of creation
Senegal	*FIRST*	1973 or 2007
	FNRAA	2008
	FNRI	To be established
South Africa	*NRF*	1918 (Research Grants Board)
	MRC	1969
	WRC	1971
	TIA	2008
Tanzania	*COSTECH*	1988
	NFAST	1995
	NRF	To be established
Uganda	NIF	2002
	STIF	2009
	UNCST	2009
Zambia	*NRC*	To be established
	NTBC	2001
	NSTC	1999
	SRF	2007
	NTBF	2011
	NTIA	To be established
	NRIF	To be established
	STIYF	2007
Zimbabwe	*RCZ*	1986
	RDCIF	2004/2005

Notes:
1. Cameroon has no national competitive research fund; FONER – despite its name – can hardly be considered as a competitive research fund
2. Acronyms indicated in *italics* can be described as funding councils/intermediaries

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Knowledge Production and Contradictory Functions in African Higher Education

Edited by Nico Cloete, Peter Maassen and Tracy Bailey

AFRICAN MINDS

A NOTE ABOUT THE PEER REVIEW PROCESS

This open access publication forms part of the African Minds peer reviewed, academic books list, the broad mission of which is to support the dissemination of African scholarship and to foster access, openness and debate in the pursuit of growing and deepening the African knowledge base. *Knowledge Production and Contradictory Functions in African Higher Education* was reviewed by two external peers with expert knowledge in higher education in general and in African higher education in particular. Copies of the reviews are available from the publisher on request.

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